WAGO

Automation for Heating, Ventilation and Air Conditioning

Contents

Air Conditioning
9 TWh

Lighting
62 TWh

Hot Water
23 TWh

Non-Residential Buildings
37%

Room Heating
245 TWh

Source: BMWi, 2017

Support the Energy Transition with WAGO

Efficient energy consumption, optimal system operation and continuous improvement are just a few requirements that buildings must continue meeting – even after renovation or during new construction. Beyond base rental prices, users must factor operating costs for energy and maintenance into the bottom line. Therefore, it pays to look closely at the main factors behind building energy costs.

Heating, ventilation and air-conditioning (HVAC) systems are some of a building's biggest costs. About 65 billion in costs for building energy occur annually in Germany.* 37% (24 billion) of these costs are in non-residential buildings. Take a closer look at the energy consumption of non-residential buildings. When you do, it becomes apparent that energy for room heating, with 245 TWh (72%) and lighting with 62 TWh (18%), overwhelmingly take the greatest share of energy consumption for these buildings.

Assuredly, the energy expense and the associated costs alone are adequate reasons to be concerned with the energy-saving potential in HVAC systems. If that were not

enough, climate change calls for immediate countermeasures such as CO_2 reductions. However, the objective of a 40% reduction in CO_2 emissions by 2020 compared to 1990 will not be reached in Germany. This is because the renovation rate is far too low, among other factors.

Building Automation from WAGO Pays Off
Building automation from WAGO helps lower energy costs and CO_2 emissions for both new buildings and renovation objects. Automatically regulating HVAC systems minimizes energy consumption and improves a building's climate. Planning and implementing HVAC systems requires extensive knowledge from every building automation professional – from creating sophisticated control programs to visualizing energy flows. Extensive libraries with ready-made system macros from WAGO typically make extensive programming unnecessary. Using these system macros contributes to standardization, significantly reducing costs.

This applies to both new buildings and renovation objects. Up-to-date building technology and efficiency-enhancing

HVAC automation make a significant contribution to helping new construction meet today's energy savings regulations. For renovation objects, the maximum savings potential can be attained with corresponding control strategies and operations monitoring. This applies equally to schools, office and management buildings, commercial and industrial buildings, hospitals, department or retail stores, sports facilities or museums, as well as hotels and restaurants.

Exploiting Potential Savings
Approximately 20% of Europe's final energy consumption could be saved by doubling boiler room energy efficiency via system-specific measures or by improving the energy efficiency of the building envelope.
A key part of the solution lies in system-related applications. The measure of success here depends on leveraging the huge potential for savings through modernizing outdated heating and ventilation technology.

According to the EPBD (Energy Performance of Buildings Directive) from 30 May 2018, published by the European Parliament and the Council of the European Union, the EU is committed to developing a sustainable, competitive, secure and decarbonized energy system by 2050. To achieve this goal, EU member states and investors need measures to meet the long-term greenhouse gas emissions reduction target by 2050 and decarbonize the building stock, which accounts for about 36% of all CO_2 emissions in the Union. The measures described have not yet been adopted in the Building Energy Act (GEG, successor to the Energy Saving Ordinance EnEV). However, this is only a matter of time, as adoption in national legislation is mandatory.

One basic requirement for planning a building's technical systems: Everyone who participates in the construction shares a common and clear language. Among other standards, this is based on DIN EN ISO 16484-3.

Furthermore, the DIN EN 15232:2017 Standard (Energy Performance of Buildings – Impact of Building Automation, Controls and Building Management) involves extensive calculations and simulations to assess the potential savings that could stem from modernization through automation. In offices, this standard allows up to 25% of heating-energy savings to be economically generated through building and room automation – without changing the building envelope. The DIN EN also recommends KPIs that, after all fine-tuning is complete, will inform the operator of system disruptions before they lead to energy cost increases. Furthermore, the DIN EN also proposes KPIs which, after adjustment, notify the operator of system faults before they increase energy costs.
Users and system operators can have a major influence on energy consumption through automation. Examples include integrating an automated system switch-off (when not needed) or intelligently adapting a room temperature and demand-based HVAC system control.

These automated control functions enable you to fully exploit – and benefit from – potential savings. Therefore, combining HVAC macros with other *e!COCKPIT* function blocks enables users to merge virtually every building system into one cohesive plan that effectively economizes the entire building.

Info

WAGO's eu.bac membership demonstrates its commitment and expertise in automation and controls. eu.bac, the European Building Automation and Controls Association, is a professional alliance of manufacturers and suppliers for home and building automation.

eu.bac european building automation controls association

Your Benefits with HVAC Automation from WAGO:

- Cost savings through good price/performance ratio in procurement and lower ongoing operating costs
- Worldwide approvals
- Software for ease of use
- Ready-to-use programs (macros)
- Expand or modify system at any time
- Integration of standardized bus systems

HVAC Primary System Solutions

An Efficient Process: Step-by-Step

Energy efficiency hinges on sensibly planning a building's technical systems. Modern automation systems conveniently combine all possible protocols and interfaces into one system – as opposed to the requirements of larger properties with mixed forms.

The WAGO I/O System 750 is the hardware solution to meet this challenge. The controller, which takes on control tasks for building automation, can be easily expanded using various I/O modules – virtually any device can be connected to the system. Configuration, programming and visualization are easily performed using WAGO's available software packages. In addition to building automation, WAGO has a well-established track record in building installations.

This experience is reflected in WAGO's integrated approach that cost-effectively combines these two worlds.

Your Benefits with the WAGO I/O System:

- Modular design
- Fieldbus-independent
- Future-proof, scalable solution
- Planning freedom via flexible solutions

HVAC Primary System Solutions

Universal, Compact, Economical – the WAGO I/O System

Simplify the engineering, control and visualization of your projects with the PFC200 Controller thanks to *e!COCKPIT* and Linux®.

Bring your innovations to market faster and earn a quicker return on investment: WAGO offers you both with its new end-to-end software engineering. The PFC200 PLC family is the perfect match. Its *e!RUNTIME*-based runtime environment and real-time-capable Linux® operating system make the PFC200 Controller an efficient control solution for your automation applications.

Your Benefits with the PFC200 Controller:

- Programming according to IEC 61131-3
- Can be combined with high-level languages
- PLC and IT functions in one device
- Multiple interfaces, functions and application areas
- High cybersecurity standards (SSL, SSH, OpenVPN and firewall)
- Remote access via mobile communications

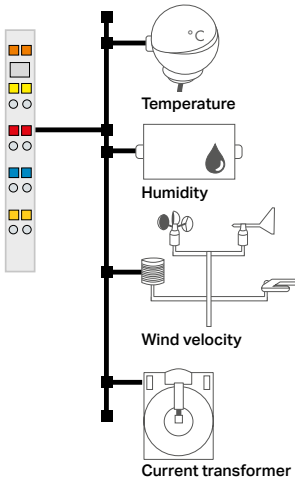**Modbus®-Capable Manual Operation for the Control Cabinet Door**

Many types of operation and display modules for different data point combinations are available. The controller connects via an RS-485 interface and communicates via Modbus RTU.
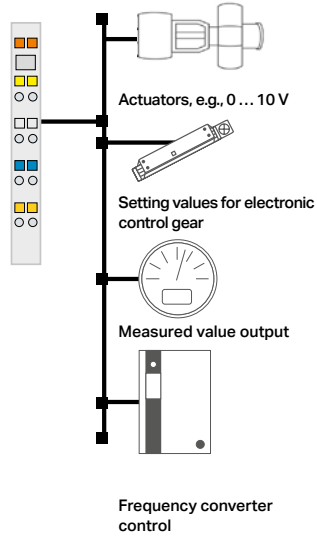
Your Benefits:
- Clear system status configuration and display
- Manual override of outputs via Modbus®
- Low wiring costs
- Minimum mounting depth
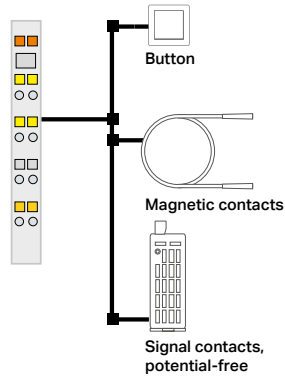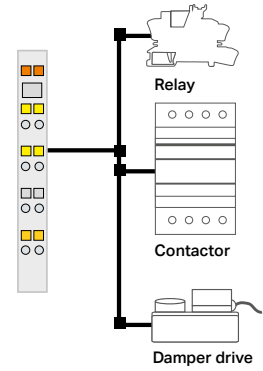- Library for integration into the I/O System

Analog Input Modules

Temperature

Humidity

Wind velocity

Current transformer

Analog Output Modules

Actuators, e.g., 0 … 10 V

Setting values for electronic control gear

Measured value output

Frequency converter control

Digital Input Modules

Button

Magnetic contacts

Signal contacts, potential-free

Digital Output Modules

Relay

Contactor

Damper drive

Communication Modules
RS-232 C/RS-485

RS-232 C/ RS-485

Display

Romutec manual operation interface

Modbus RTU/RS-485

Actuator

Specialty Modules

DALI 2

SMI

MP BUS
TECHNOLOGY BY BELIMO

M-Bus

KNX

KNX

LonWorks
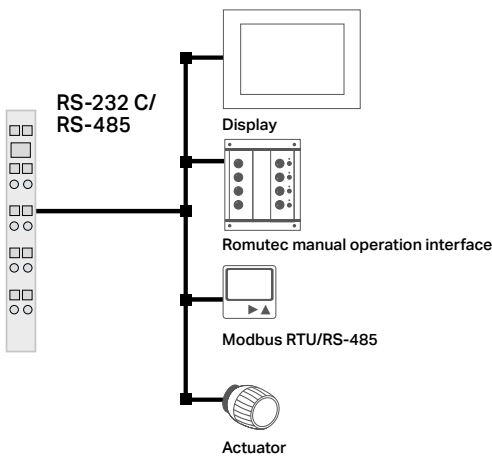
3-Phase Power Measurement Modules
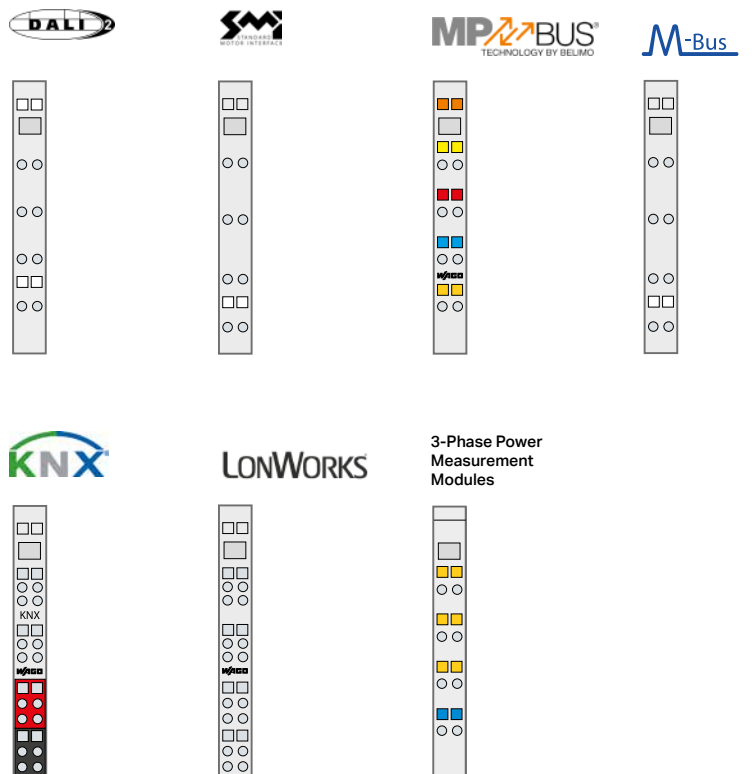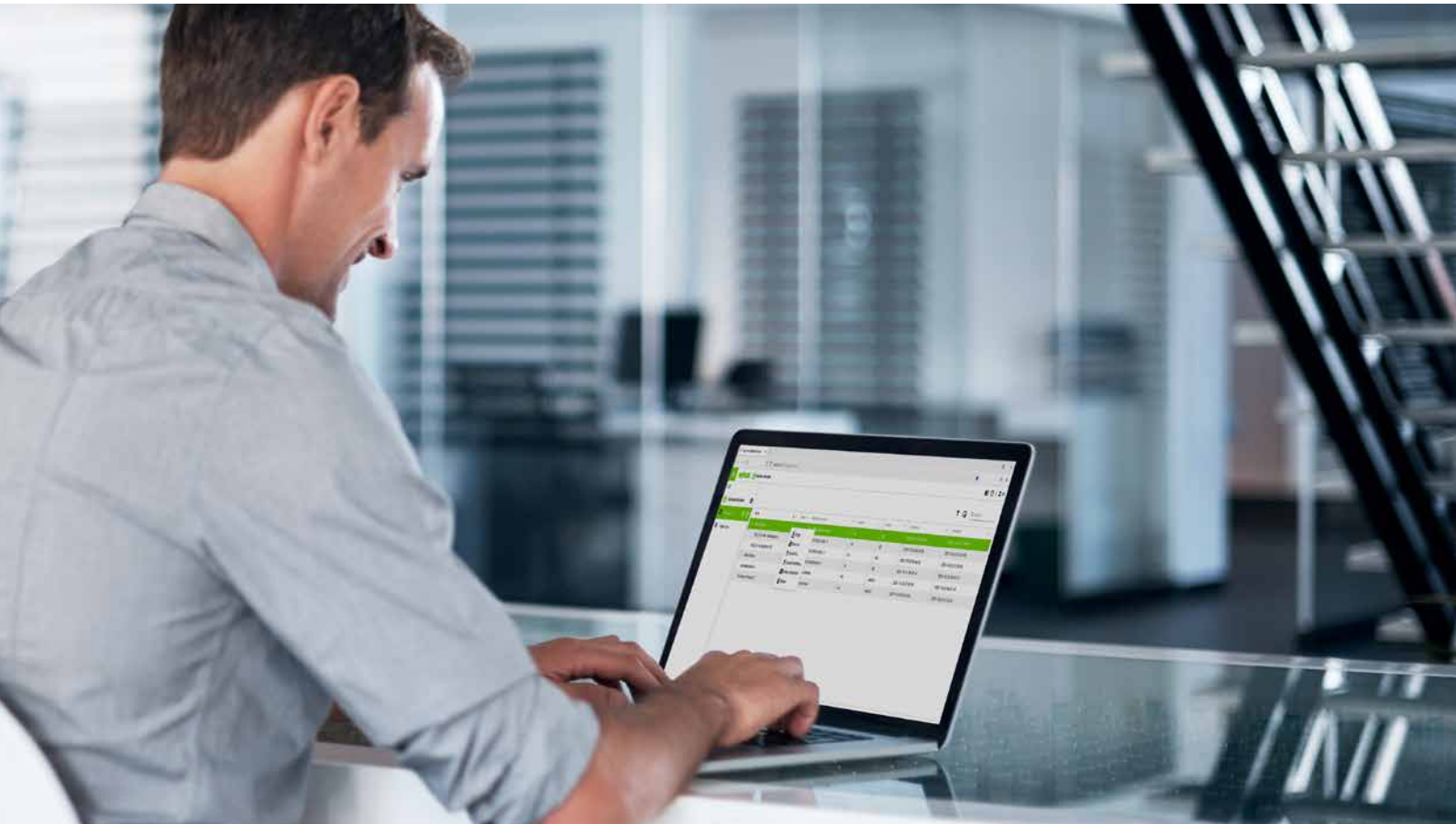
Basic Software

Programming and Configuring with WAGO

Automation projects demand shorter and shorter implementation times and increasingly complex structures, and software represents a greater and greater portion of the overall solution. That makes automation engineering a key factor influencing your project's success.

WAGO offers two software packages for project engineering, allowing you to expedite operational system startup, while reducing development time for automation projects. The PC-based WAGO Engineering Environment is an integrated development environment that supports every automation task, from hardware configuration and programming, to simulation and visualization, to commissioning – an all-in-one software package. WAGO Solution Builder is an integrated, efficient software solution specifically for building automation. It allows you to take a holistic approach to project engineering – throughout the entire lifecycle of your building. Here the workflow is optimized to keep the processes of creating the entire project in the office (offline) and commissioning it on-site (online) separate.

**Your Benefits with the
WAGO Engineering Environment:**
- Integration of new devices like Touch Panels and second-generation PFCs
- A smart design
- Graphical network configuration
- Extensive libraries with ready-made system macros

Your Benefits with WAGO Solution Builder:
- A clearly organized representation of the system on a Web interface
- An efficient workflow to save engineering time
- Intelligent bulk processing of data and devices helps prevent errors
- Simple, comprehensive project documentation with one mouse click

Configuring	Programming	Visualizing	Diagnosing

Communication in the BACnet®
and Modbus® Network

WAGO offers software tools specifically engineered for select technologies, applications and products. Among these are WAGO's BACnet® and Modbus® Configurators, which allow devices connected to a specific network to be easily and efficiently addressed and parameterized.
The Modbus® Configurator is integrated into *e!COCKPIT*; the BACnet® Configurator is an

add-on application for the *e!COCKPIT* programming environment. Both configurators are used directly in the programming environment for quickly integrating the WAGO controllers into the corresponding networks.
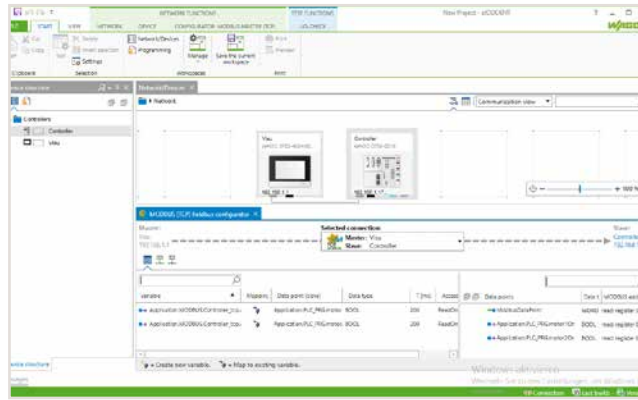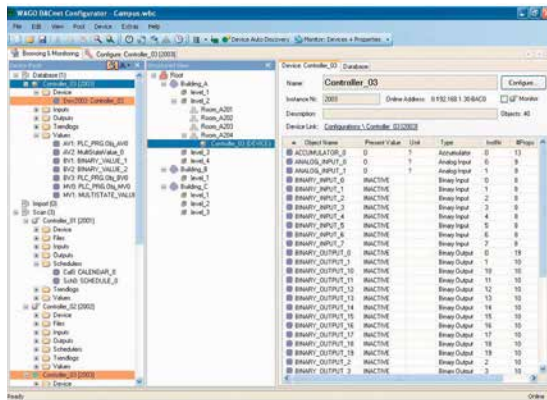
WAGO-I/O-*CHECK* in *e!COCKPIT*

As a component of *e!COCKPIT,* WAGO-I/O-*CHECK* is an easy-to-use application for operating and displaying a WAGO I/O System 750's controller without the node being connected to a fieldbus system. The software reads the configuration from the node and displays it graphically on the screen. This graphic can be printed together with a configuration list as documentation. With WAGO-I/O-*CHECK*, it is possible to display and specify the process data of the I/O modules. The field wiring, including all sensors and actuators, can thus be checked before commissioning.
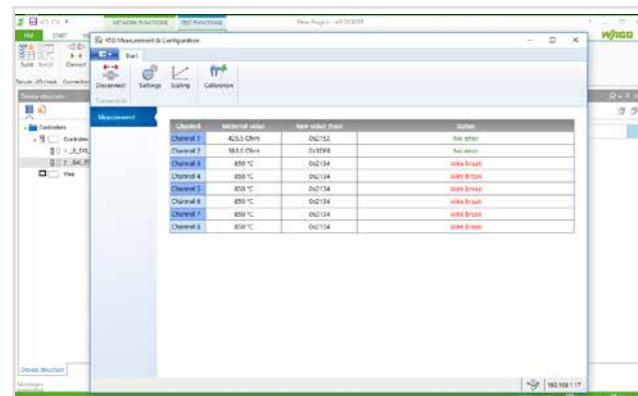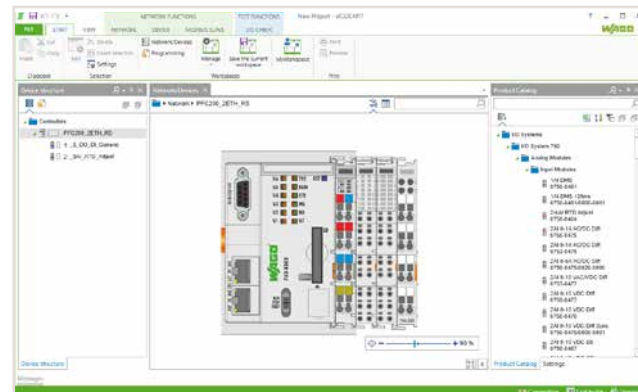
System Macros

Parameter Setting – Not Programming

A Brief Introduction

WAGO provides comprehensive templates, which include ready-made system macros for typical applications. This time-saving convenience minimizes the effort of HVAC configuration for users. After rapidly configuring the application – via simple data point and system parameter assignment – users can commission the completed application directly.

To simplify programming, there are a multitude of pre-configured function blocks and applications available free of charge in the download area. In addition, there are templates for creating programs. These comprehensive examples of complex tasks – including functional system macros with the appropriate documentation – are available in PDF format. The manual override function within the system macros allows the operator to override individual system parts using the visualization screens.

A system macro consists of various function blocks that are linked to one another for controlling an entire ventilation system, for example. The function blocks consist of sub-functions that are combined to allow control of a larger task, such as a complete air-conditioning system. Using a system macro, you can also display and configure the entire system in a visualization interface.

Your Benefits with HVAC Application Macros:

- Ready-to-use applications
- No extensive programming required
- Saves time and costs during commissioning
- Reuse standardized solutions
- Customize via open source macros
- Available as free download under
  www.wago.com/hvacdownload

System Macros

Parameter Setting – Not Programming
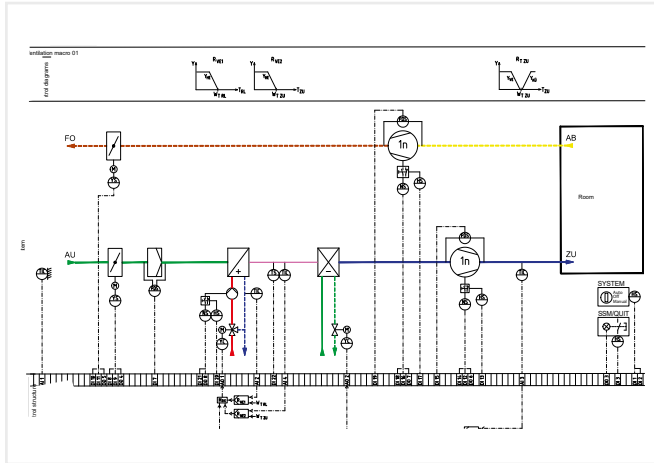
System Diagram

Matching the applications, standardized system diagrams for CAD and TRIC are available for easy integration into standard planning tools.

Graphical Function Block Representation

Using the graphical function block representation, a macro's functions can be clearly displayed to simplify assembly.

System Macro Components
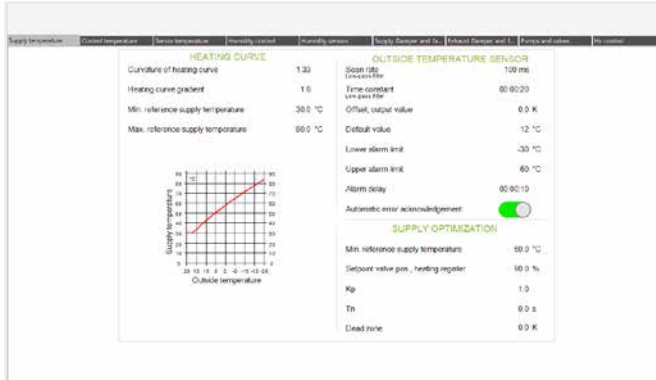
Configuration Visualization

In addition to a visualization of the selected application, macros allow the user to easily adjust all relevant parameters through an online graphical interface.

System Visualization

Furthermore, the macros contain complete visualization interfaces for each completed application allowing you to monitor and control functions via the controller's embedded Web-server.

System Macros Overview

Parameter Setting – Not Programming

District Heating Transfer Station Macros

- District heating transfer station with supply temperature control and return temperature limitation

Boiler Macros

- Boiler strategy with two dual-stage boilers
- Boiler strategy with one dual-stage and one modulating boiler
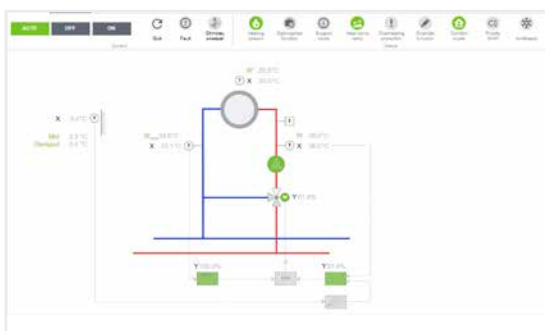
Heating Circuit Macros

- Heating circuit with circulation pump
- Heating circuit with heat exchanger, supply temperature control and return temperature limitation
- Heating circuit with supply temperature control and return temperature limitation
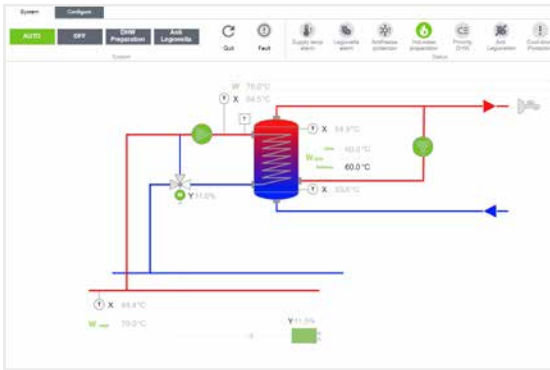
Domestic Water Heating Macros

- Domestic water heating with charging pump
- Domestic hot water production with heat exchanger
- Residential hot water production with supply temperature monitoring
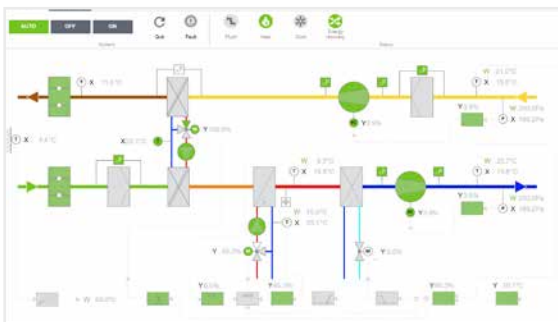
Ventilation Macros

- **Supply air temperature control or cascade control**
- Single-stage fan
- Dual-stage fan
- Mixed air fan with frequency converter
- Plate-type heat exchanger
- Run-around coil system
- Rotary heat exchanger

- **Full air-conditioning system**
- Fan with frequency converter
- Mixed air humidification and dehumidification

Single-Room Control

- PID single-room controller

Generation

Example: Boiler Macro
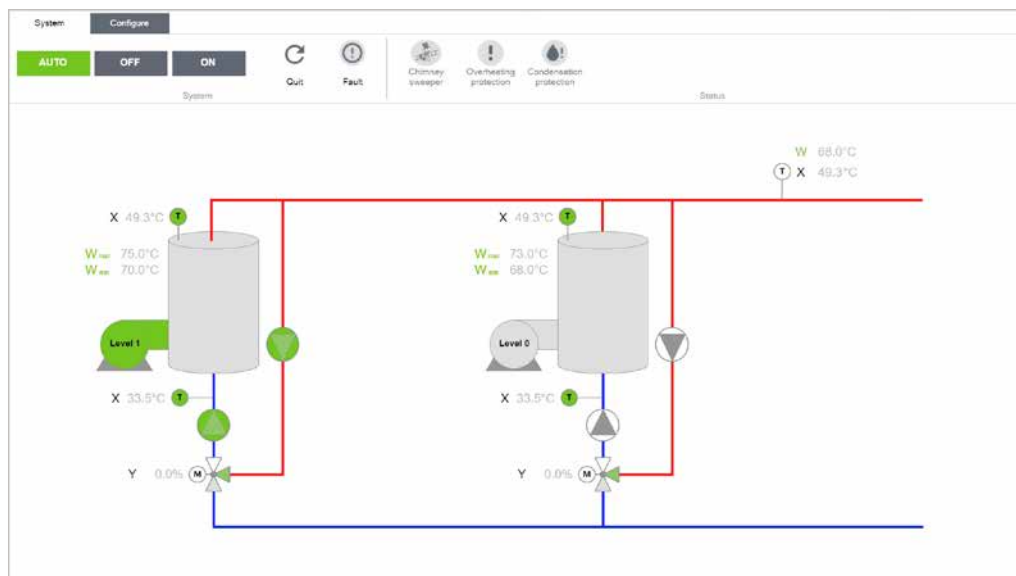
A boiler strategy with two dual-stage boilers meets these requirements:

Boiler Strategy

- Boiler strategy for two boilers
- Demand-dependent connection to the second boiler
- Dynamic switching of the lead boiler
- Automatic switching of the lead boiler in the event of a fault

Boiler Control

- Maximum limitation of the boiler supply temperature
- Minimum return flow temperature monitoring
- Maximum return flow temperature limit
- Unrestricted selection between mixing pump, three-way valve and boiler damper
- Boiler anti-condensation protection
- Anti-jamming function for pumps and valves
- Differing parameters for lead boiler and lag boiler
- Different start-up processes based on the components used

Distribution

Example: Heating Circuit Macro
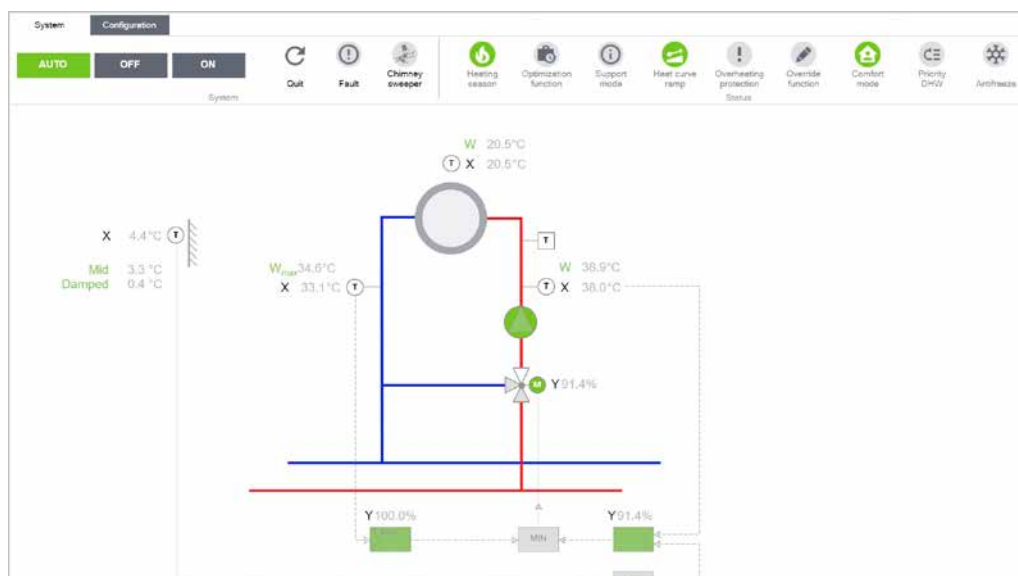
Heating circuit with supply temperature control and return temperature limitation

The following requirements are met:

- Heating limit depends on outside temperature to determine heating periods
- Selection between overnight economy mode (parallel shift of the heating curve) and overnight shutdown (support mode)
- Self-regulating start optimization
- Heating curve
- Supply temperature setpoint with ramp function (crack protection)
- PI supply temperature controller

- Chimney sweep function with time limit
- Mandatory override (e.g., domestic water heating or overheating protection of the primary system)
- Return flow temperature limit based on outside temperature
- Antifreeze controller
- Demand-dependent pump activation
- Anti-jamming function for pumps and valves

Consumption

Example: Ventilation Macro
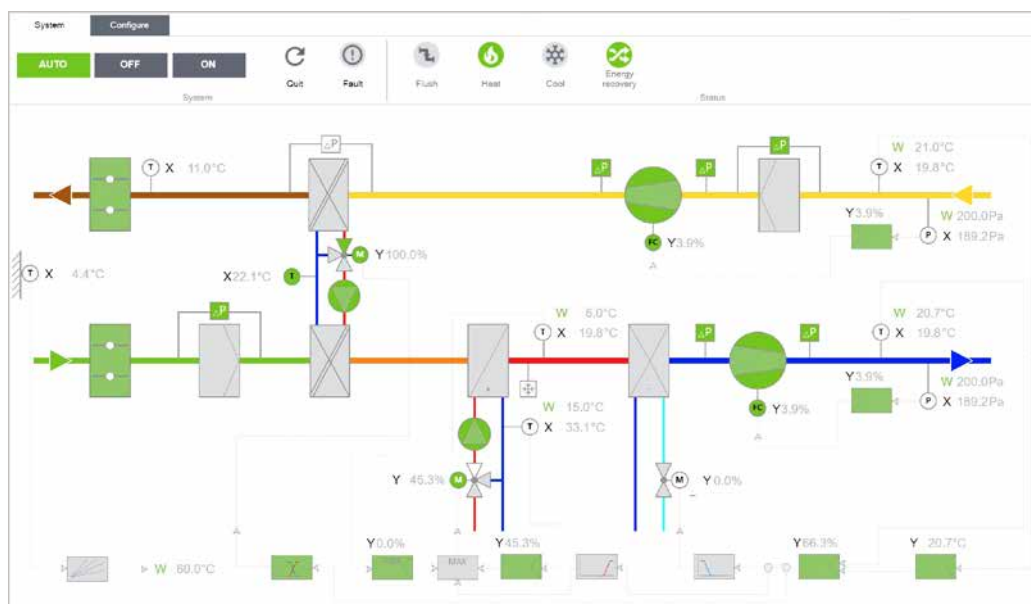
Cascade control with mixed air and fan with frequency converter

The following requirements are met:

- Continuous fan with contactor and operational monitoring
- Pressure control in supply and exhaust air duct
- Upstream and downstream frost protection
- Demand-dependent pump switching
- Anti-jamming function for pumps and valves
- Control of mixed air and exhaust air dampers
- Outside air filter monitoring
- Energy-optimized room/exhaust temperature control with summer increase per DIN 1946

- Supply air temperature control in cooling/mixed air/ heating sequences
- Summer night ventilation
- Optimized setpoint supply temperature measurement

Operating mode	Heating Setpoint			Cooling Setpoint
Comfort mode	21 °C			23 °C
Standby mode	19 °C			25 °C
Night mode	17 °C			27 °C
Frost/heat protection	7 °C	Antifreeze protection	Heat protection	35 °C

Dead zone
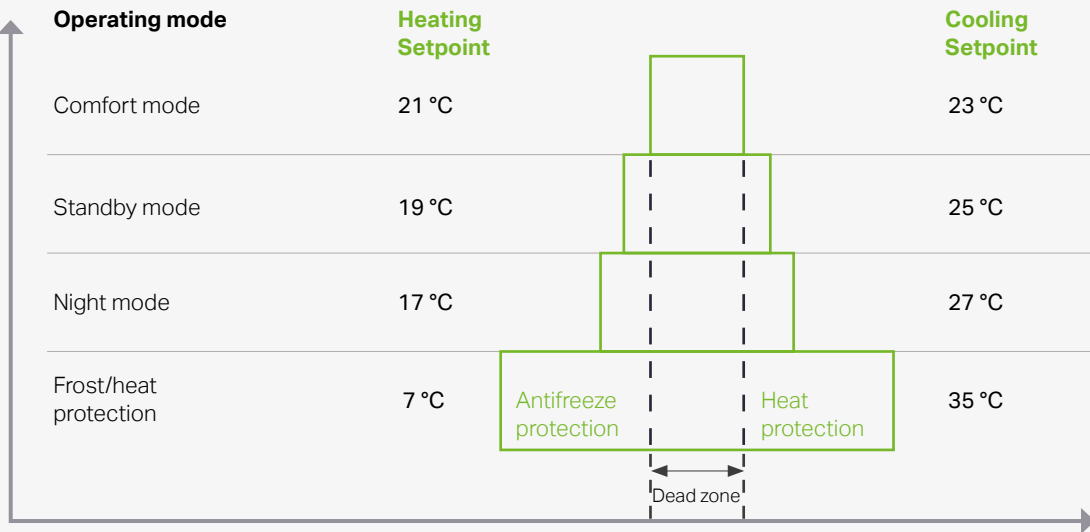
Utilization

Single-Room Control

PID Single-Room Controller

This function block permits single-room temperature control while accounting for external factors.

- Separate PID controllers for heating and cooling
- Three different operating modes (comfort, standby and night)
- Adjustable dead zone between heating and cooling
- Setpoint correction via room operating panel

- Window contact analysis to determine switch to frost/heat protection (support mode)
- Dew point detector monitoring
- Optimized setpoint supply temperature measurement


```
                  FbBACnetHeatingCircuit_01
EN                                                    ENO
I_MV_Switch                               sSystemErrorBanner
I_AI_RoomTemperature                               xSystemOK
I_AI_OutsideTemperature                                xHorn
I_AI_SupplyTemperature            xSignalLampMalfunction
I_AI_ReturnTemperature                          xSystemError
I_BI_MaximumThermostat                                 xPump
I_BI_RepairSwitchPump                               rY_Valve
I_BI_MotorProtectionPump                            wY_Valve
I_BI_Quit                              xHeatingCircuitActive
I_BI_ChimneySweepFunction                      xHeatingPeriod
I_AV_ReferenceComfortTemperature              xOptimization
xSwitchOnComfortMode                            xComfortMode
iTimeBeforeOperation                            xSupportMode
xPriorityDHWPreparation                            xOverride
xOverheatingProtection                         xChimneySweep
dtActualTime                             xMaximumThermostat
typConfigHeatingCircuit_01         rDampedOutsideTemperature
I_BO_SystemError                    rReferenceRoomTemperature
I_BO_Horn                         rReferenceSupplyTemperature
I_BO_SignalLampMalfunction             rMaxReturnTemperature
I_BO_Pump                                              xRamp
T_AO_Y_Valve                                   xRampOverride
I_BV_HeatingCircuitActive                         xAntifreeze
I_BV_HeatingPeriod
I_BV_Optimization
I_BV_ComfortMode
I_BV_SupportMode
I_BV_ChimneySweep
I_BV_Antifreeze
I_BV_Ramp
```

Operating Mode	Heating Setpoint	Cooling Setpoint
Comfort mode	Basic setpoint: 21 °C	Basic setpoint + Dead zone: 2 K
Standby mode	Basic setpoint, temperature decrease – Standby mode	Basic setpoint + Dead zone + Temperature increase Standby mode
Night mode	Basic setpoint, temperature decrease – Night mode	Basic setpoint + Dead zone + Temperature increase, night mode
Frost/heat protection	Frost protection setpoint: 7 °C	Heat protection setpoint: 35 °C
Dew point alarm	Setting value: 0 (heating off)	Setting value: 0 (cooling off)

Visualization

Web Visualization

The macro library includes graphic elements that enable fast, simple creation of a user interface with *e!COCKPIT*. Visualization is performed via HTML5 pages on a Web-server, which runs locally on the ETHERNET Controllers. This allows the HTML5 visualization to be displayed in a Web browser on any Internet-connected computer, e.g., for remote maintenance. The Web visualization can also be accessed on a tablet or smartphone using an app.

Touch Panels 600

Three Function Classes

Operation, monitoring and diagnostics in buildings: Touch panels with different display sizes in the Web Panel, Visu Panel and Control Panel variants, combine a contemporary design with impressive features and are available for small- to mid-sized control and visualization tasks.

Web Panel
Web Panels are provided with an optimized Web browser for accessing controllers via standard Web protocols with integrated Web visualization for display. They can display Web visualizations created with *e!COCKPIT* and based on state-of-the-art technology like HTML5.

Visu Panel
Visu Panels are suitable for direct display of a visualization generated with *e!COCKPIT* and for retrieving the data it references from PFC200 Controllers or other field devices via Modbus TCP. These panels can also provide a Web visualization via the integrated Webserver.

Control Panel
Control Panels allow simultaneous execution of a control and visualization task generated with *e!COCKPIT*, offering a very compact automation solution. Using a dedicated library, these panels become IoT controllers that send data from the field level to the cloud.

Industrial Switches

Eco Unmanaged

- Plug & play operation (Auto MDI-X)
- Megabit and gigabit variants
- Vibration and shock resistance
- DIN-rail adapter

Standard Unmanaged

- Up to 16 Gigabit ports + SFP slots
- Diagnostics via LEDs and relay
- High temperature range (−40 … 70 °C)
- Redundant power supply

Lean Managed

- Intuitive configuration for automation engineers
- Simple network diagnostics in the browser
- Media redundancy with RSTP/ERPS
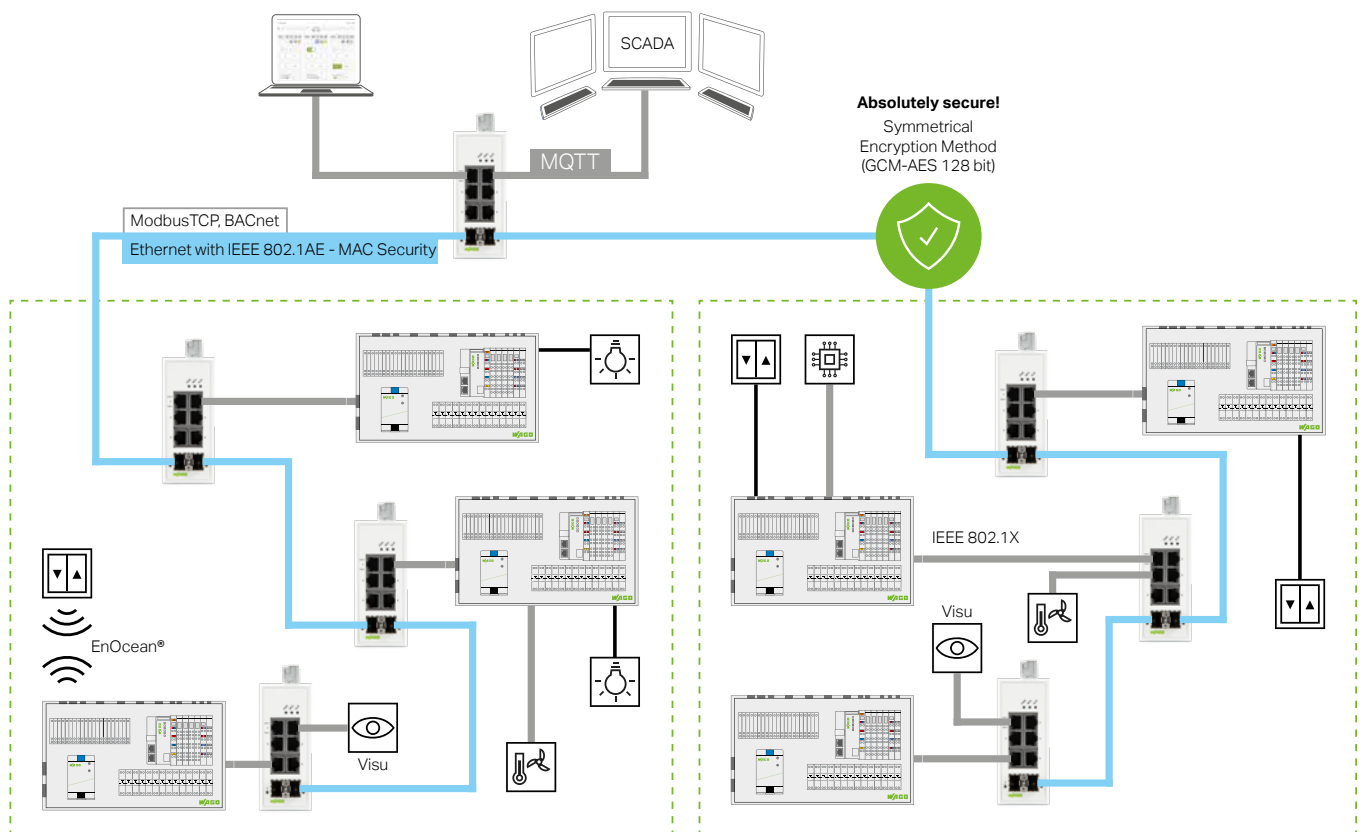- Network security basic functions

PROFINET® Managed

- Configuration/diagnostics in the PROFINET® system
- PROFINET®-certified (CC-B)
- Cyclically readable process image
- Potential-free networking over 80 km

Fully Managed

- Fast network redundancy (< 30 ms)
- Diagnostics (SNMPv3, Modbus®, Syslog …)
- Security (SSH, VLAN, 802.1X, ACL …)
- Extended network functions:
  (Routing, IPv6, LACP, DHCP …)

Industrial Managed Switch with Built-in Encryption Feature

SCADA

MQTT

Absolutely secure!
Symmetrical
Encryption Method
(GCM-AES 128 bit)

ModbusTCP, BACnet

Ethernet with IEEE 802.1AE - MAC Security

EnOcean®

Visu

IEEE 802.1X

Visu

WAGO's industrial managed switches make it easy for users to increase the security of their building automation applications. This innovation integrates cybersecurity functions: 128-bit encryption of data packets on two ports. That makes it possible to integrate secure data transmission into an existing network – regardless of the protocol and without application changes. Encryption meets the IEEE 802.1AE standard (IEEE MAC Security Standard), ensuring data integrity and sender authentication alongside high data throughput.

Secure HVAC Automation Networking with Cloud Connectivity

Added Value for Your Company

Recording, digitizing and linking data profitably – these core ideas don't just belong to Industry 4.0. As the interface between automation and information technology, cloud connectivity meets this challenge. Installed on the WAGO PFC Controllers, system data can be transferred via MQTT to nearly any cloud, e.g., Microsoft Azure, Amazon Web Services, IBM Cloud, SAP Cloud, and last but not least, WAGO Cloud, where the information can be aggregated and used for analysis. This capability creates true added value for your company – whether for increasing the efficiency of operational systems, implementing energy management or developing additional end-customer services.

**Full Control at All Times**

The cloud connection data configuration is customized via the WAGO controller's Web-Based Management. Furthermore, with the corresponding IEC library from *e!COCKPIT*, you determine what information should be transferred to the cloud and what information should be processed locally on the controllers exclusively. This allows you to maintain complete control of your data at all times. Controller information, such as run/stop, connection status and device information can also be transferred to a cloud solution with cloud connectivity or distributed via a MQTT broker. Cloud connectivity has been a standard feature of the PFC Controllers; the required library has been included in *e!COCKPIT*.

Your Benefits:

- Direct connection from the field level to the cloud
- Expansion of existing systems with our PFC Controllers as an IoT gateway
- Distributed data acquisition and visualization from anywhere
- Connection to Microsoft Azure, Amazon Web Services, IBM Cloud SAP Cloud or other MQTT brokers via standardized MQTT protocol
- High level of security thanks to TLS encryption
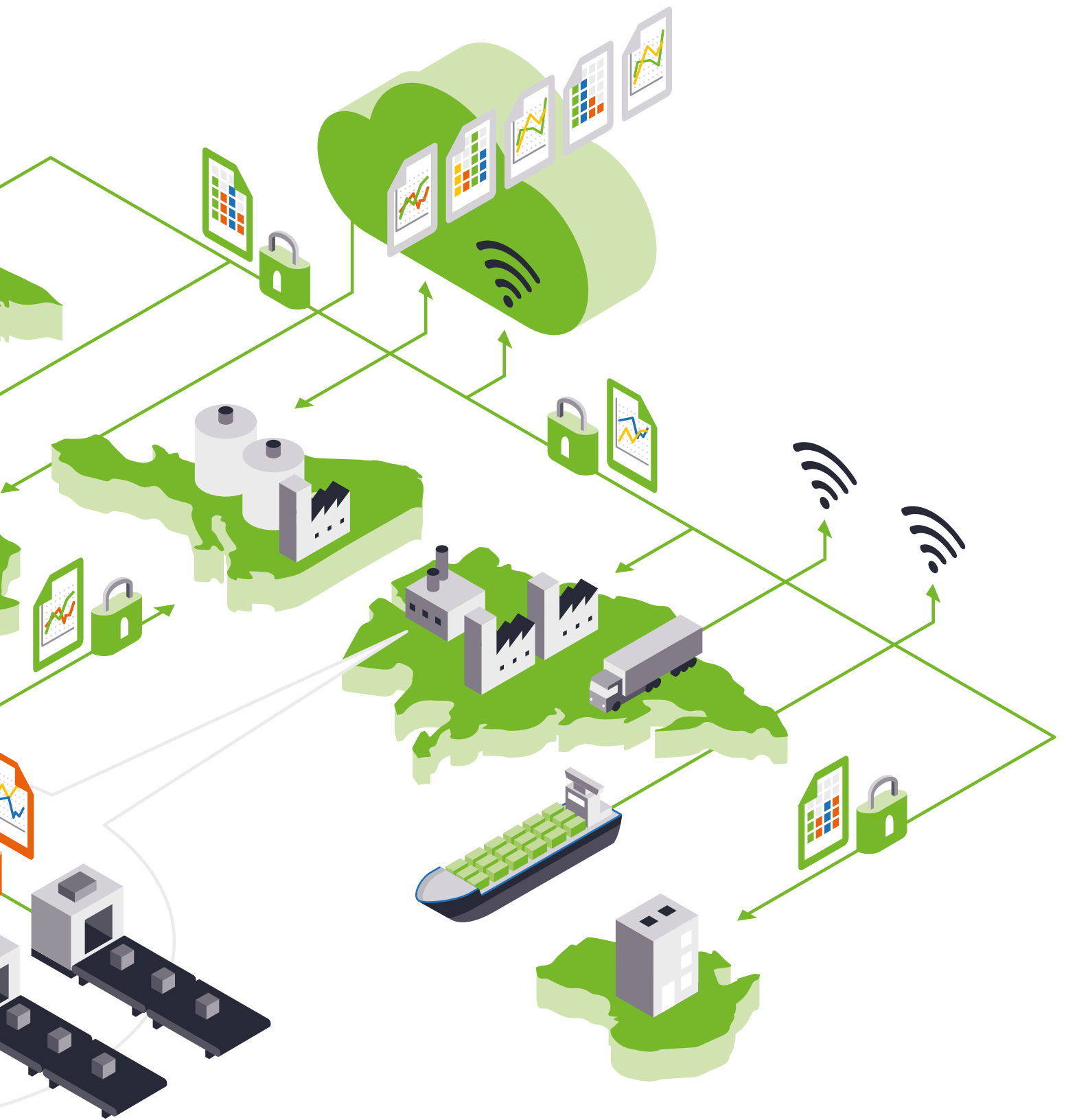
Universal, Compact, Economical – the WAGO I/O System

Management

The automation stations connect to the building management system at the management level. Standardized protocols facilitate simple data exchange.
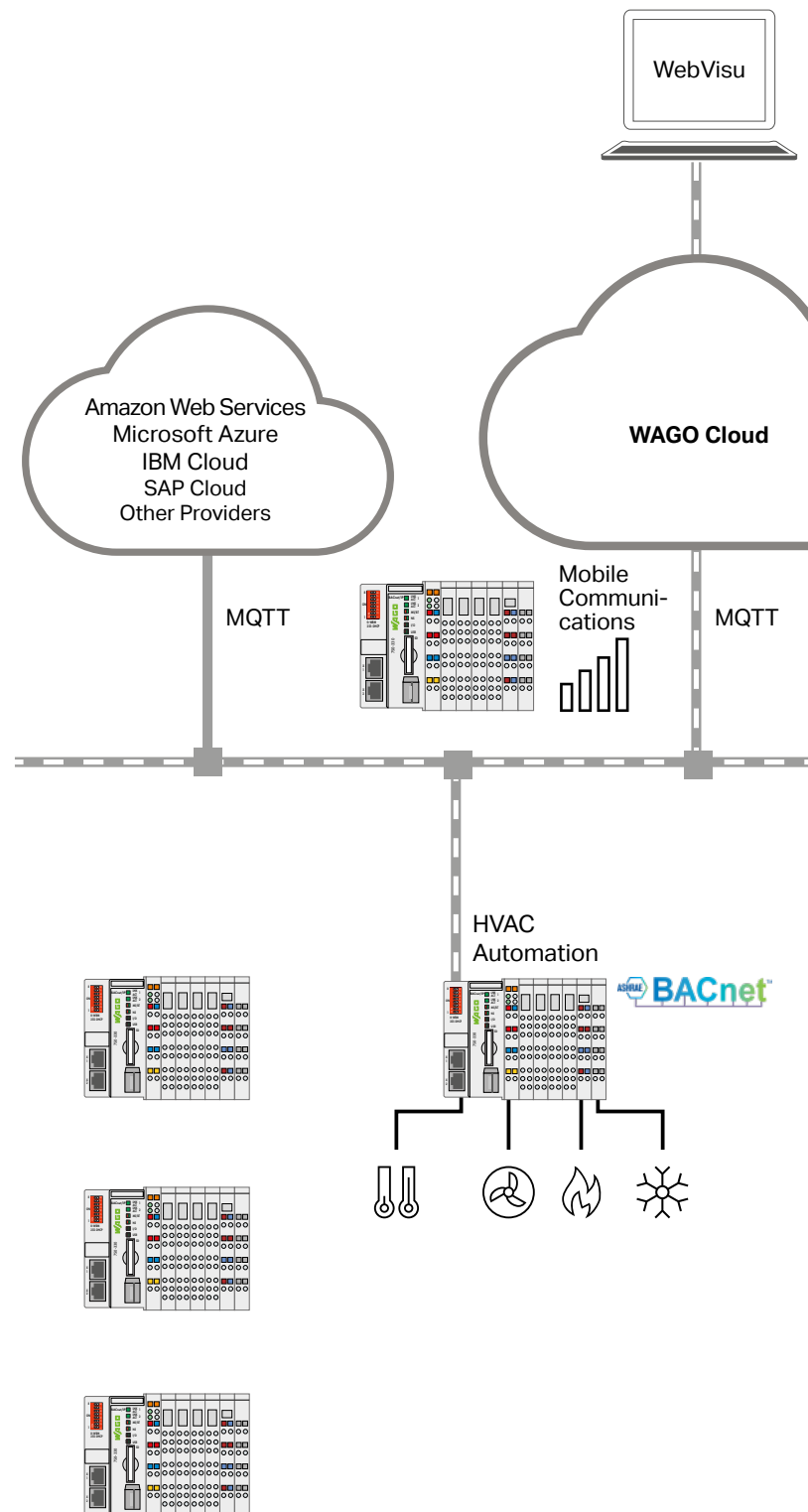
Thanks to modern information technology, the most important information from building automation is no longer restricted to in-house building management; it's now available at any time and place. However, this requires certain technical preconditions. WAGO's PFC Controllers are equipped with cloud connectivity and transfer data to WAGO Cloud – or any other MQTT broker.
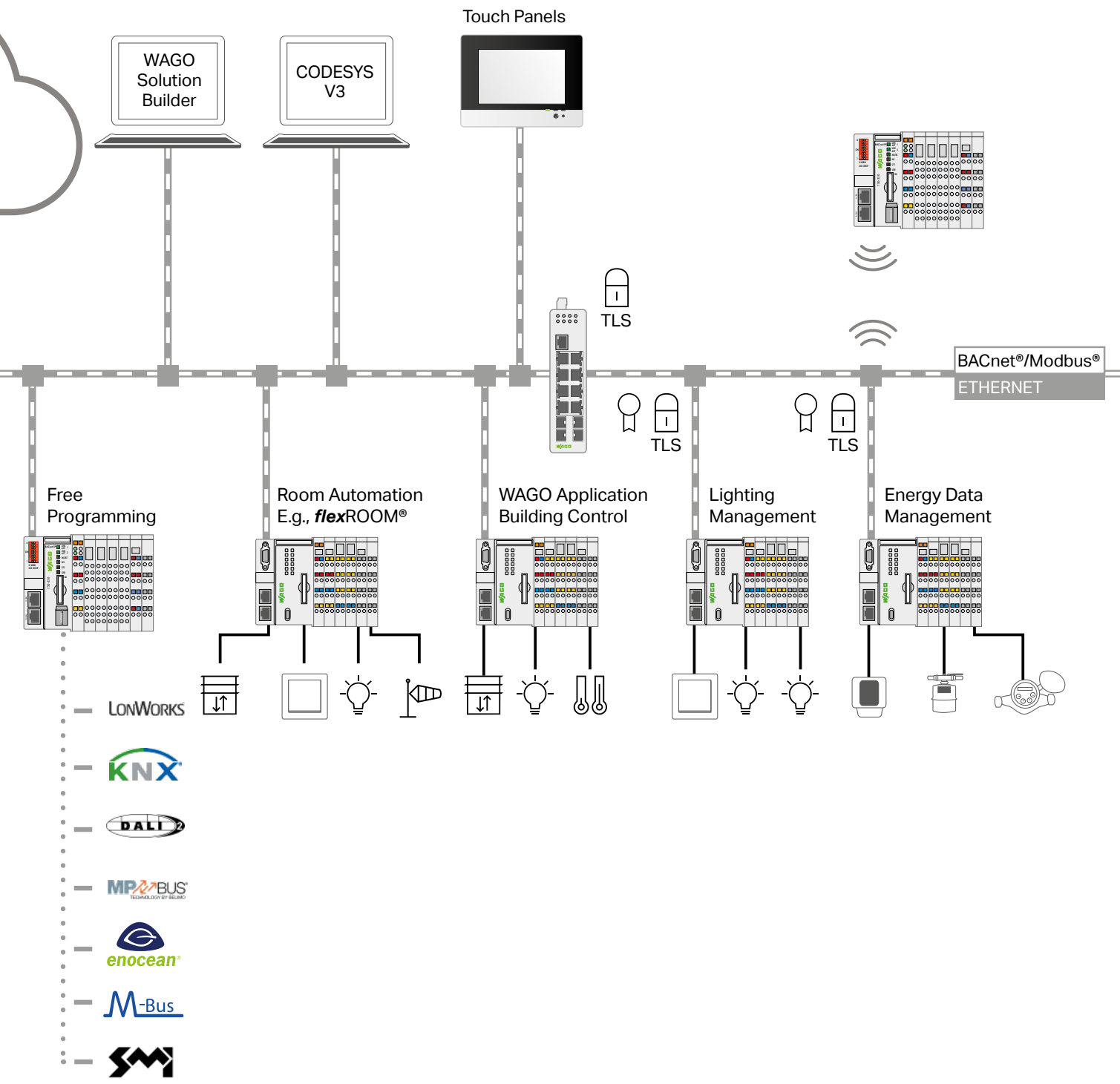
Automation

Automation stations control and regulate operational systems. ETHERNET has long since established itself as the dominant transmission medium within automation. As such, WAGO's automation stations can be easily and efficiently interlinked using open, standardized bus protocols for building automation (e.g., BACnet IP, KNX IP or Modbus/TCP). I/O modules and fieldbus interfaces permit nearly any sensor or actuator to be connected from the field.

Field

Flexible, easy-to-install media are required at the field level. This is why WAGO offers a wide variety of solutions: From products for directly connecting standard sensors and actuators via I/O modules, to a variety of fieldbus interfaces for two-wire subsystems (e.g., Modbus RTU, MP-Bus, M-Bus, BACnet MS/TP, KNX TP1 and LonWorks®), to connect with radio systems like EnOcean®.

WebVisu

Amazon Web Services
Microsoft Azure
IBM Cloud
SAP Cloud
Other Providers

WAGO Cloud

MQTT

Mobile Communications

MQTT

HVAC Automation

BACnet™

Touch Panels

WAGO Solution Builder

CODESYS V3

TLS

BACnet®/Modbus®
ETHERNET

TLS

TLS

Free Programming

Room Automation
E.g., *flex*ROOM®

WAGO Application
Building Control

Lighting Management

Energy Data
Management

LONWORKS

KNX

DALI 2

MP BUS
TECHNOLOGY BY BELIMO

enocean®

M-Bus

SMI

BACnet®

A Fast Control Solution for Complex Applications

BACnet® is a standardized building automation communication protocol that adheres to DIN EN ISO 16484-5. BACnet® standardizes communication between products from different manufacturers. To achieve this, the standard defines device profiles, services, communication objects, object properties and transmission media. WAGO's BACnet® Controllers comply with the BACnet® Building Controller (B-BC) profile and communicate via **BACnet/IP** or **BACnet MS/TP**.

WAGO BACnet® Configurator
The BACnet® Configurator is useful for configuring and operating BACnet® Controllers in a heterogeneous BACnet® network. Tasks such as logically structuring the network, addressing the controller, and configuring both client and server can be performed on the configuration interface. In addition, the properties of BACnet® objects can be accessed using a Web browser.

Additional Benefits
Beyond "BACnet Building Controller" (B-BC) profile compliance as defined in the BACnet® Standard, WAGO's freely programmable BACnet® Controllers are compatible with the associated BACnet® Interoperability Building Blocks (BIBBs). A large variety of available input, output and specialty modules for sub-buses such as KNX®, MP-Bus and DALI complete the system, making WAGO BACnet® Controllers incredibly versatile.

Tested and Certified
Manufacturers of BACnet® products can take advantage of conformity tests at recognized, accredited test agencies to prove their devices comply with BACnet® Standard ISO 16484-5/ANSI ASHRAE 135.

WAGO's BACnet® Controllers are certified by independent test laboratories and carry the globally recognized BTL logo!

We also meet special requirements of local markets, such as the AMEV certificate. If you have questions about tests or certificates, please contact us!
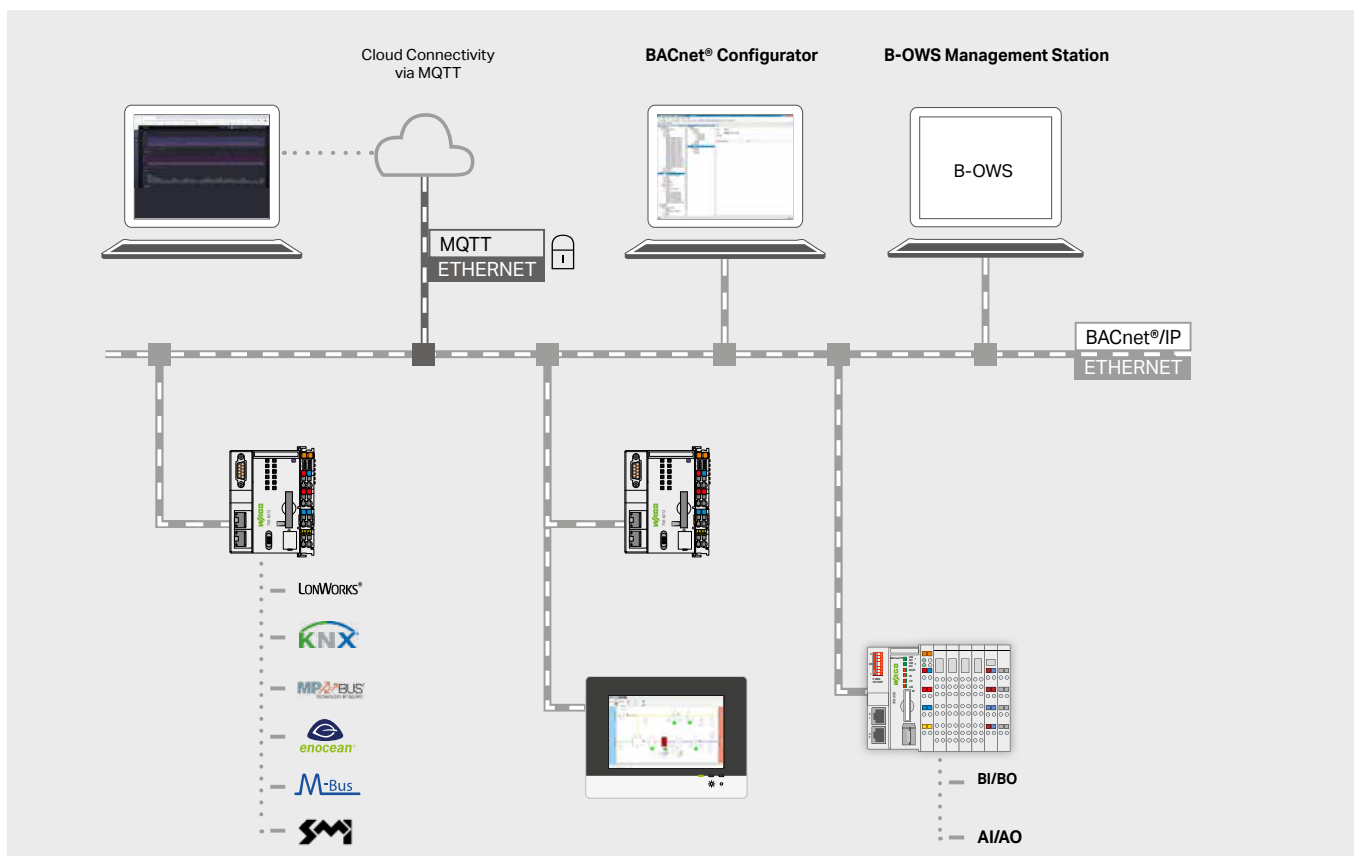
Modbus TCP/IP

Fast and Lean Communication

Extending 1979's Modbus TCP protocol for PLCs, the well-established Modbus® protocol has become the de facto standard for building automation. The advantage: Modbus® is a streamlined protocol that ensures ultra-fast ETHERNET data transmission. A manufacturer-independent data structure also permits communication between devices from different manufacturers.

Thus, Modbus TCP is recommended for applications that collect data and/or network intelligent controllers with self-sufficient control logic. Therefore, in addition to the respective fieldbus protocol, WAGO's ETHERNET-based controllers for building automation also support Modbus TCP.

Modbus RTU establishes serial master/slave communication via the RS-232 or RS-485 interface. In order to communicate via Modbus RTU, the serial communication parameters must first be known and/or defined. These parameters include baud rate, parity and stop bits. The slave address(es) to be addressed by the master also come into play. The cable length with RS-232 is limited to 15 m and with the RS-485, 1200 m.

Your Benefits:

- Uniform data exchange compliant with standards
- Rapid data transmission
- Independent of technology and manufacturer

MP-Bus Connection

Control According to Sensors

The MP-Bus controls HVAC actuators for dampers, regulator valves and VAV air volume controls.

The actuators connect to sensors (temperature, humidity and on/off switch) that are also accessible via MP-Bus. Devices equipped with an MP-Bus connection can communicate with a higher-level control system via a bus cable.

Up to eight actuators can be controlled by an MP-Bus master. The 750-643 MP-Bus Master Module can manage up to eight slaves (actuators) and eight sensors (one sensor can be connected to each slave) via common bus cable. This capability significantly reduces actuator and sensor wiring (for MP-bus cable lengths, see 750-643 Module's manual). There is no line topology limitation –

star, ring, tree or mixed configurations are possible. Up to eight slaves can be connected to a master. The actuators feature Multi-Function Technology (MFT) and include damper actuators, MFT(2) valve actuators, MFT fire damper actuators, VAV compact controllers and Belimo's FLS window ventilation system. Data can be exchanged between a master and the slaves, such as absolute/relative volumetric flow, minimum/maximum limits, angular position, sensor value, operating status and fault messages.

The WAGO-I/O-PRO Software is required for commissioning the I/O node.

Your Benefits:

- Up to eight drives on the M-Bus can be actuated via the MP-Master.
- It is possible to connect one active or passive sensor and one switch to the MFT2/MP drive.
- No line topology limitations: Star, ring, tree or mixed configurations are possible.
- Data can be exchanged between a master and the slaves, such as absolute/relative volumetric flow, minimum/maximum limits, angular position, sensor value, operating status and fault messages.

M-Bus Master

Connect Energy and Consumption Meters Directly

M-Bus

System Description

The M-Bus (Meter-Bus) reads different types of utility meters (e.g., electricity, heat, water). It is standardized as a European standard for all meters, excluding electricity meters.

The M-Bus Master communicates with the M-Bus slaves and when required, reads energy consumption data via the M-Bus two-wire line and transmits it to the higher-level control system for further processing or visualization.

Alternatively, PLC queries can be implemented via the PLC using IEC 61131-3 function blocks or via a PC application. The M-Bus slaves are powered via the M-Bus master. The use of a separate level converter is not required.

The WAGO-I/O-PRO Software is required for commissioning the I/O node.

Your Benefits:

▪ Direct (no external level inverters) and cost-effective connection of M-Bus devices to the I/O system
▪ Highly flexible by combining with other I/O modules and I/O system's interfaces
▪ Use of multiple modules for larger data volumes

Services

Technical Support

WAGO's technical support staff is ready to assist you with advice and guidance – from selecting the right product, through telephone support during commissioning, all the way up to on-site troubleshooting. You directly benefit from knowledgeable WAGO experts who dramatically expedite project implementation.

WAGO provides advice and support with:
- Product selection
- Product commissioning
- Troubleshooting
- Technical questions about WAGO's wide product range

Product Support
Phone: +49 (571) 887-44 555
Email: support.de@wago.com

Project Support

WAGO's technical support offers consulting and project planning services to help devise the best possible solutions for your custom building automation and installation projects. Our experienced team of professionals will gladly help you implement your projects with WAGO products.

Large-scale applications include:
- Production facilities and warehouses
- Office buildings
- Shops and display areas
- Schools
- Hospitals
- Airports

Planning and project design:
- Conceptual design
- Network planning
- Application design
- Component selection
- Quote generation

WAGO helps customers with:
- Advice while planning the construction project from experts with years of project experience
- Customizing solutions to ensure the technical and financial success of large projects
- Technical support while implementing building projects

Project Sales Building Automation
Phone: +49 (571) 887-49160
Email: info.projektplanung.de@wago.com

Your Notes

3-Phase Power Measurement Module

Rogowski Coil RT 500

Power Supplies

Plug-In Current Transformer *picoMAX®*

Relay Module

RJ-45 Connectors

Lean Managed Switches

Relays

Building Automation Components

The products and solutions outlined in this brochure create a solid foundation for building automation. However, additional peripheral systems, control modules and components are required for complete automation solutions.

WAGO not only provides a wide range of products, but can also furnish tailor-made solutions consisting of fully equipped system distribution boxes.

The Key Information a Glance:

- **WAGO I/O System**
  Benefits of WAGO's successful fieldbus system: a solution with scalable performance, high integration density and an unbeatable price/performance ratio
- **Industrial Switches – Redundant, stable network solutions that are also economical:**
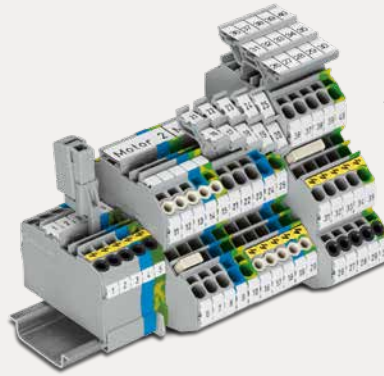 With switches from WAGO, reliable data distributors are ready for your machines and systems.
- **Pre-Assembled Custom Solutions**
  WAGO's product specialists have the experience and efficient solutions to assist you from initial specs to final install.

Controllers

TOPJOB® S Rail-Mount Terminal Blocks

WINSTA® Pluggable Connection System

System Distribution
Box

- **WAGO Power Supplies**
  Provide 24 V to power controllers and IPCs.
- **Network Infrastructure Components**
  From a simple switch to configurable communication
  capabilities with a fiber optic connection
- **Customizable ETHERNET**
  User-configurable ETHERNET RJ-45 connectors
- **Interface Modules**
  For RJ-45 patch cables and universal connections, such
  as a 9-pole Sub-D RS-232 connection
- **Relays**
  To control loads, such as lights and shutter drives
  and much more.

- ***WINSTA®* Pluggable Connection System**
  Innovative connectors from the WAGO *WINSTA®* line for
  pre-assembled components ensure fast, safe on-site in-
  stallation; they accommodate conductor cross-sections
  up to 4 mm^2 (12 AWG) and nominal currents up to 25 A.
- **Screwless Rail-Mount Terminal Blocks**
  TOPJOB® S is a range of screwless rail-mount terminal
  blocks for building installation for conductors with
  cross-sections from 1.5 to 16 mm2 (16 to 6 AWG).
- **Current Measurement**
  Coupled with electronic interface devices and the
  WAGO I/O System 750, WAGO offers a comprehensive
  range of perfectly coordinated energy efficiency solu-
  tions.

Your Benefits:

- Less assembly time
- Error-free installation
- Simplified commissioning

Retrofit Complex HVAC Solutions with WAGO

Chiller Automation

How do you install a new absorptions chiller, including peripherals, in a shipping container for use in an existing building? With the right partner for systems and building technology and the right automation solution. CHRISTOFFERS from Delmenhorst (Lower Saxony) and WAGO from Minden (North Rhine-Westphalia) show how. From frequency converters, to the heat exchanger, to the connection to the building control system – all chiller automation runs via a PFC200. In this project, the WAGO I/O System 750 once again demonstrates its suitability for both series production and custom solutions.

Some things just take a lot of time – municipal bureaucracies, for example, as many a building owner in Germany can testify. In a construction project for a northern German university site, the red tape was drastically slowing things. To retrofit an existing building with a chiller, an annex was required for the new technology. Because there was no chance that the construction permit application would be processed and approved in the foreseeable future, the project required ingenuity – as well as an innovative partner with extensive expertise.
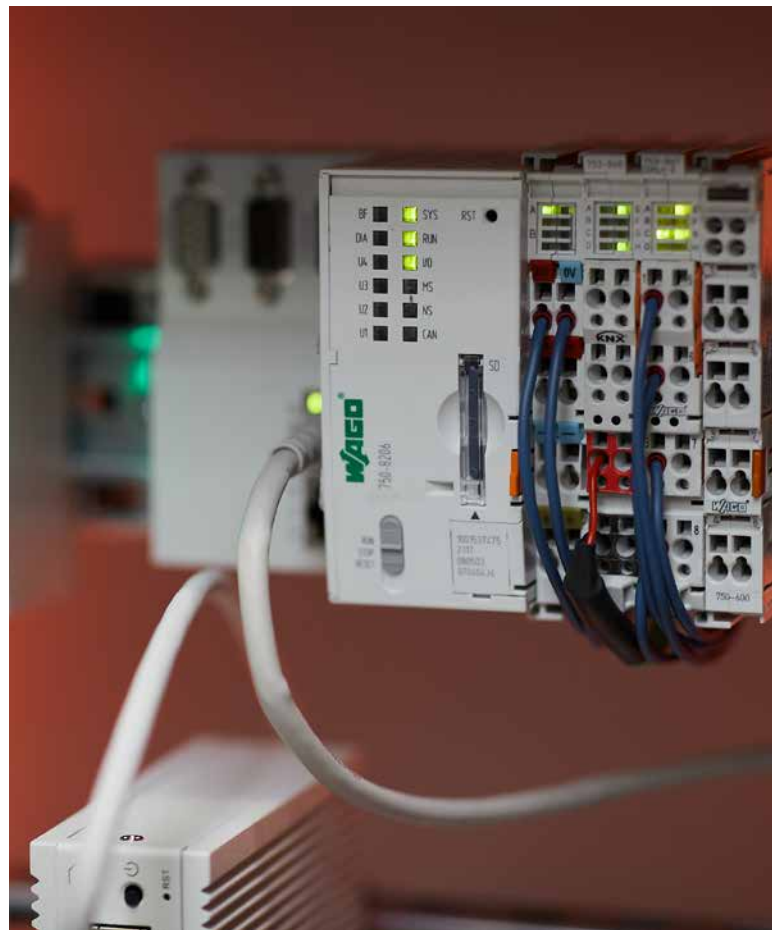
Using Artificial Intelligence to Reduce Heating and Air-Conditioning Costs

Increasing Efficiency through Machine Learning

Automation specialists mrm² have developed a system that employs machine learning to make heating and cooling office and industrial buildings significantly more efficient, reducing energy costs by up to 20%. WAGO provides the PFC200 Controller and Edge Computer, two key components in the system.

It all started a few years ago, when Marc Gruber, co-founder and Managing Director of mrm², wanted to build a house for his family. Gruber's company, which includes around 30 employees and is headquartered in Bad Dit-

zenbach-Gosbach in Swabia, specializes in intelligent automation technology. So obviously, building technology from a pre-digital era was unlikely to meet his standards for use in his own house. "I took a good look around at all of the products available to automatically control heating systems – and was completely underwhelmed. Everything on offer was simplistic, without a shred of intelligence," he recalls. Only one possibility remained: "If there's no intelligent solution on the market, we'll just have to build one ourselves!"